



TECHNICAL MEMORANDUM

Subject: Sitewide Groundwater Monitoring Program
Groundwater Sampling for Mercury and TCE
June 2007 Groundwater Sampling Event (third of four sampling rounds)
Caribbean Petroleum Refining, LP facility, Bayamón, Puerto Rico.

To Mr. Domingo Perez, Environmental Engineer
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From: Joseph Lysonski, PG, CGWP, Sr. Scientist, Anderson, Mulholland & Associates, Inc.

Date: November 26, 2007

1.0 Introduction

This technical memorandum presents the results from the June 2007 sampling event for the Sitewide Groundwater Monitoring Program (SGMP) of the RCRA Facility Investigation (RFI) at the Caribbean Petroleum Refining, LP (CPR) facility in Bayamón, Puerto Rico. This sampling event is the third of four semiannual rounds of groundwater sampling for total and dissolved mercury at 14 wells, and at four wells for volatile organic compounds (VOCs), including trichloroethene (TCE). The sampling for mercury is being done as per a proposal to the Environmental Protection Agency (EPA) in a technical memorandum dated December 27, 2005, and as agreed to by EPA in an email of February 23, 2006. The VOC sampling is being done in response to an email request from EPA dated May 22, 2006.

The objective of the mercury investigation is to collect additional data for evaluating groundwater quality with respect to mercury at the CPR facility. The objective of the VOC sampling is to supplement previous sampling data from May and October 2003 at wells associated with the chlorinated solvent plume.

As part of the sampling program, mercury is being sampled at 14 wells. At 13 of these wells, mercury has been detected at least once during various previous sampling events between March 1996 and September 2005. Mercury is also being sampled for delineation purposes at one additional well (MW-17B) screened in the carbonate sediment. Historic mercury detections exceeded the EPA maximum contaminant level (MCL) of 2 ug/L at only two of the wells (MW-21B and MW-78B, see Figure 1), which are located at the northeastern corner of the facility. Of the 259 soil samples and 9 sediment samples that have been collected during the RFI, no significant mercury contamination has been detected.

The mercury and VOC sampling program consists of four rounds of semi-annual groundwater sampling. The first and second sampling rounds were performed in July and September 2006, respectively. The third sampling round, which is the subject of this report, was performed in June 2007. The fourth sampling round will be performed in December 2007.

This technical memorandum includes information requested by EPA in a December 26, 2006 technical review of the technical memoranda for the July and September 2006 sampling events. CPR responded to EPA's technical review comments on January 22, 2007. In an email dated February 6, 2007, EPA determined that all the responses were acceptable and that CPR should include the response to comment information in the next submission of the SGMP report. The information requested by EPA concerned presentation and discussion of historical results, discussion of the slightly acidic groundwater conditions at certain wells, and documentation of all important monitoring well information on field data sheets, including depth of pump placement during sampling.

2.0 Summary of Work

Groundwater samples were collected from 14 monitoring wells at the CPR facility and analyzed for total and dissolved mercury. Sampling for total dissolved solids (TDS) and total suspended solids (TSS) was also performed at all 14 wells. The purpose of the TDS and TSS sampling was to assist with the identification of any high bias to the mercury results due to turbidity in the sample. Groundwater samples were also collected from four monitoring wells and analyzed for VOCs. The groundwater sampling work was performed during June 13-21, 2007.

A summary of the wells sampled and analytical parameters is shown in the table below. A map showing the locations of the wells is provided in Figure 1.

Well	Analytical Parameters				
	VOCs	Hg - total	Hg - dissolved	TDS	TSS
<i>Old Oil Lagoon (SWMU 11) Area</i>					
MW-83B1	x				
MW-83B2	x				
MW-84B2	x				
<i>Tank Farm Area</i>					
TB-3		x	x	x	x
MW-14A2		x	x	x	x
MW-63A		x	x	x	x
<i>Waste Water Treatment Plant Area</i>					
MP-5A		x	x	x	x
MP-5B2		x	x	x	x
B-11		x	x	x	x
MW-15B2		x	x	x	x
<i>Sulfur Lagoon (SWMU 34) Area</i>					
MW-110B		x	x	x	x
<i>Undeveloped land located north of the operational area of the facility</i>					
MW-17B		x	x	x	x
MW-20B		x	x	x	x
MW-21B		x	x	x	x
MW-75B	x	x	x	x	x
MW-78B		x	x	x	x
MW-115B2		x	x	x	x

X - Indicates that the well was sampled for the parameter

The groundwater sampling was performed using EPA low-flow procedures (EPA, 1998, 2002). The general groundwater sampling procedure was as follows: the water level and well depth were measured; the purging/sampling device (bladder pump or hose for peristaltic pump) was inserted into the well; the well was purged until field indicator parameters stabilized; lastly, the well was sampled. At wells where the entire screen was within the water column, the purging/sampling device was inserted to about the mid-point of the well screen. At water-table wells with partially submerged screens, the purging/sampling device was inserted to about the mid-depth of the water column. For low-yield wells, the pump may have been inserted somewhat deeper to accommodate the greater drawdown. The wells were sampled after the water-quality indicator parameters (temperature, pH, dissolved oxygen, specific conductivity, oxidation-reduction potential, and turbidity) during purging stabilized to the criteria specified in the EPA guidance (EPA, 2002) for three consecutive measurements taken about 5 minutes apart. The field instruments were calibrated on a daily basis. Purge statistics are presented in Table 1. Groundwater sampling field data sheets are presented in Appendix A.

Sampling for mercury was performed using a peristaltic pump with dedicated Teflon-lined polyethylene tubing, except at well MW-75B. Well MW-75B was sampled using a bladder pump since it was also sampled for VOCs. Due to low yield, well B-11 was purged to dryness and sampled after sufficient recovery. Drawdown during purging greater than 0.33 ft (0.1 m) occurred at wells MP-5A, MW-14A2, MW-17B, MW-63A, and MW-110B2, although the indicator parameters stabilized at these wells.

Sampling for VOCs at wells MW-75B, MW-83B1, MW-83B2 and MW-84B2 was performed using bladder pumps. Bladder pumps were decontaminated between wells in the field using the following protocol: tap water/non-phosphate detergent scrub and rinse, deionized water rinse, isopropanol rinse, nitric acid rinse, deionized water rinse, air dry, and aluminum foil wrap. The effectiveness of the decontamination was verified by collecting an equipment blank.

Quality assurance/quality control samples included a trip blank and a field blank (VOCs only), an equipment blank, a duplicate, and a matrix spike/matrix spike duplicate. Samples for dissolved mercury were filtered in the field prior to preservation using a 0.45 micron filter. The groundwater samples were collected in bottles containing preservatives supplied by the laboratory. Samples for VOCs and mercury were preserved to a pH of less than 2 using hydrochloric acid and nitric acid, respectively. Samples were then placed on ice for shipment to the lab.

Analyses for VOCs and mercury were performed using SW-846 Method 8260B and 7470A, respectively. TDS and TSS analyses were performed using EPA Methods 160.1 and 160.2, respectively. The laboratory employed a 0.45 micron filter for TDS and TSS analyses, the same size as used for field filtering of dissolved mercury. Anderson-Mulholland & Associates, Inc. performed the field sampling. Accutest Laboratories, Inc. of Dayton, New Jersey performed the laboratory analyses.

Laboratory data were validated using EPA Region 2 standard operating procedures (SOPs) and EPA National Functional Guidelines, and certified by a Puerto Rico licensed chemist. Dr. Rafael Infante, a Puerto Rico licensed chemist, validated and certified the data.

3.0 Groundwater Sampling Results

Groundwater sampling results for total and dissolved mercury, TDS, and TSS are presented in Table 2. VOCs results are presented in Tables 3.

Mercury and VOC results were compared to groundwater screening levels consisting of EPA Maximum Contaminant Levels (MCLs) and, where MCLs were not available, to EPA Region 3 tap water risk-based screening levels (EPA Region 3, October 2007). Results for methyl tert-butyl ether (MTBE) were compared to the acceptable drinking water guideline (20 to 40 ug/L) established by EPA (EPA, 1997).

Mercury

Mercury data presented in Table 2 show that total and/or dissolved mercury were detected at 7 out of 13 wells at concentrations ranging from 0.044 B to 2.2 ug/L. The detections occurred at wells MW-17B, MW-20B, MW-21B, MW-63A, MW-75B, MW-78B, and MW-110B2. All mercury detections were below the groundwater screening level of 2 ug/L, with the exception of total mercury at well MW-78B (2.2 ug/L). At well MW-78B, dissolved mercury (1.6 ug/L) was below the screening level, however.

As discussed in the data quality section below, mercury data from well MW-14A2 were rejected during data validation since the dissolved concentration was greater than its total concentration by more than 50%. Well MW-14A2 was resampled for mercury on September 18, 2007. Equipment blanks of several field filters were also collected on November 8, 2007 and sent to the laboratory for mercury analysis to evaluate the potential for cross-contamination from field filters. The results will be presented and discussed in the next semi-annual report.

Table 3 presents historic mercury results at the sampled wells between March 1996 and March 2006 and data from the mercury investigation (July 2006 to present). The historical results show that mercury concentrations were below the screening level at all wells, except for wells MW-21B and MW-78B. Data from the mercury investigation show that exceedances of the screening level of 2 ug/L occurred only for total mercury at well MW-21B (2.3 ug/L) during July 2006 and for total mercury at well MW-78B (2.2 ug/L) during June 2007. Detections at other wells were 0.1 ug/L or less, with the exception of well MW-63A, which had a total mercury concentration of 0.86 ug/L during June 2007. Results from 7 out of 14 wells were non-detect for all three mercury investigation sampling events.

VOCs

VOC data presented in Table 4 show that TCE was detected above its MCL of 5 ug/L at wells MW-75B (67.0 ug/L in primary and 69.7 ug/L in duplicate), MW-83B1 (133 ug/L), and MW-83B2 (107 ug/L). Vinyl chloride was detected above its MCL of 2 ug/L at well MW-83B1 (2.8 ug/L). No other VOCs were detected above groundwater screening levels.

Table 5 presents historic chlorinated hydrocarbon [TCE, tetrachloroethene (PCE), cis-1,2-dichloroethene (C12DCE), trans-1,2-dichloroethene (T12DCE), and vinyl chloride (VC)] results at the sampled wells between March 1996 and March 2006 and data from the current investigation (July 2006 to present). March 2007 data from interim measures semi-annual groundwater sampling at well MW-75B are also included.

The historic data presented in Table 5 show that TCE exceeded its screening level of 5 ug/L at wells MW-75B, MW-83B1, MW-83B2, and MW-84B2. The highest detection of 154 J ug/L occurred at well MW-83B1 during May 2003. This is consistent with the latest June 2007 results which show that the highest TCE concentration also occurs at well MW-83B1 (133 ug/L). Well MW-83B1 is believed to be on the upgradient side of the CPR facility. No significant differences in TCE concentrations occur between well MW-83B1 (screened from 27 to 37 ft bgl in the carbonate sediment) and deep well MW-83B2 (screened from 50.9 to 60.9 ft bgl in the carbonate sediment), although concentrations at well MW-83B1 were greater than at deep well MW-83B2 in 3 out of 5 sampling events. The TCE concentration at well MW-84B2, which showed a concentration up to 68.7 ug/L in October 2003, is currently (June 2007) non-detect. Well MW-84B2 is believed to be generally side gradient of the TCE plume.

The historic data also show that PCE, C12DCE, and T12DCE were below screening levels at all wells, with the exception of C12DCE at well MW-75B (71.7 ug/L) during October 2003, which slightly exceeded its screening level of 70 ug/L. The C12DCE concentration at well MW-75B is currently (June 2007) 19.3 ug/L, which is below its screening level. The historic data showed that VC was intermittently detected above its screening level of 2 ug/L at wells MW-75B and MW-83B1, but always below the screening level at wells MW-83B2 and MW-84B2. The highest VC concentration occurred at well MW-75B (5.8 ug/L) during October 2003; the current (June 2007) concentration is 1.7 ug/L. C12DCE, T12DCE, and VC are degradation products of TCE.

At the conclusion of the four rounds of groundwater sampling for this project, additional discussion of historic data will be provided, including a discussion of any concentrations trends.

pH

Measurements of pH and specific conductivity from the July and September 2006 and the current June 2007 sampling events are summarized in Table 4. The data show slightly acidic pH measurements (below a pH of 5) at three wells (MW-14A2, MW-63A, and MP-5A), with a pH range of 4.22 to 5.49. These three wells are screened near the top of the water table in the overburden. The groundwater at these wells also exhibits a low specific conductivity ranging from 186 to 282 uS/cm, which is indicative of relatively recent rainfall recharge. The slightly acidic groundwater at the wells is attributed to leaching of naturally occurring organic acids from decay of vegetation during recent groundwater recharge.

Total and dissolved mercury levels at wells MW-14A2 and MW-5A were non-detect during the mercury investigation, indicating no impact from the slightly acidic groundwater conditions. At well MW-63A, total mercury ranged from 0.22 to 0.86 ug/L; dissolved mercury ranged from 0.044 B to 0.1 B ug/L. RFI soil sampling results closest to well MW-63A, which are from location 35-4 at SWMU 35 located about 90 ft north and up-gradient, showed a mercury level of 0.45 J mg/kg (4-6 ft) and 0.05 BJ mg/kg (6-8 ft). These results are within or not significantly different from the facility mercury soil background level of 0.34 mg/kg. Since mercury (as mercuric chloride) is more mobile in an acidic environment, the mercury detection at well MW-63A may be influenced by background soil conditions and the slightly acidic environment. Nevertheless, mercury did not exceed its groundwater screening level of 2 ug/L.

Data Quality

All data were validated using EPA Region 2 SOPs. The data validation report is presented in Appendix B.

All mercury data (except at well MW-14A2), and VOC, TSS, and TDS data were determined to be useable. Mercury data from well MW-14A2 were rejected since the dissolved concentration was greater than its total concentration by more than 50%. As previously discussed, well MW-14A2 was resampled for mercury in September 2007. Additionally, equipment blanks of several field filters were collected in November 2007 to evaluate the potential for cross-contamination from field filters.

No qualification of other data were necessary as part of data validation. Several VOC data were qualified by the lab as estimated (J qualifier) due to detections below the reporting limit, however. Several mercury data were B-qualified by the lab where detections were greater than the method detection limit, but less than the reporting limit. The full laboratory data package is also included in Appendix B.

4.0 References

U.S. Environmental Protection Agency (EPA), 1997. Drinking Water Advisory: Consumer Acceptability Advice and Health Effects Analysis on Methyl Tertiary-Butyl Ether (MTBE). Office of Water. EPA-833-F-97-009.

United States Environmental Protection Agency (EPA), Region 2, 1998. Groundwater Sampling Procedure, Low Stress (Low Flow) Purging and Sampling, Final SOP.

U.S. Environmental Protection Agency (EPA), 2002. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers, EPA 542-S-02-001.

United States Environmental Protection Agency (EPA), Region 3, October 2007. Risk Based Concentrations Table, Office of RCRA Technical & Programs Support Branch.

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- A. Groundwater sampling field data sheets, June 2007 (on CD-ROM in PDF format)
- B. Data validation/certification reports and full laboratory data packages for SDG J63993, June 2007 groundwater sampling (on CD-ROM in PDF format)

Tables

Table 1
Well Purging Statistics
Sitewide Groundwater Monitoring Program, June 2007
Caribbean Petroleum Refining, LP
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Well Number	TB-3	MP-5A	MP-5B2	B-11	MW-14A2	MW-15B2	MW-17B	MW-20B	MW-21B	MW-63A
Sample Date	20-Jun-07	21-Jun-07	21-Jun-07	18-Jun-07	21-Jun-07	21-Jun-07	18-Jun-07	20-Jun-07	20-Jun-07	19-Jun-07
Initial Static Water Level (ft TOC)	13.00	4.82	6.04	8.20	6.85	7.3	4.41	4.78	2.02	7.96
Drawdown (ft)	0.00	1.51	0.07	4.51	4.77	0.00	2.07	0.02	0.02	1.01
Temperature (°C)	29.61	27.25	27.73	see Note 2	29.01	29.19	25.77	26.26	26.18	29.34
pH	6.69	4.64	6.62	see Note 2	4.22	6.85	6.44	6.70	6.80	4.11
Dissolved Oxygen (mg/L)	3.87	0.96	4.26	see Note 2	1.88	1.99	0.66	4.53	4.49	2.00
Specific Conductivity (uS/cm)	807	215	986	see Note 2	191	1097	496	1440	1000	186
Oxidation Reduction Potential (mV)	195	340	-24	see Note 2	418	-4	231	32	117	376
Turbidity (NTU)(see Note 3)	2.1	14.2	5.3	see Note 2	0.6	1.3	0.0	14.4	4.5	15.8
Flow rate (mL/min)	100	300	275	see Note 2	300	200	400	225	300	100

Table 1
Well Purging Statistics
Sitewide Groundwater Monitoring Program, June 2007
Caribbean Petroleum Refining, LP
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Well Number	MW-75B	MW-78B	MW-83B1	MW-83B2	MW-84B2	MW-110B2	MW-115B2
Sample Date	14-Jun-07	18-Jun-07	13-Jun-07	13-Jun-07	14-Jun-07	19-Jun-07	19-Jun-07
Initial Static Water Level (ft TOC)	2.07	4.30	6.99	6.80	6.06	7.05	5.60
Drawdown (ft)	0.03	0.16	0.00	0.16	0.09	0.82	0.01
Temperature (°C)	26.95	27.13	27.38	28.91	27.46	26.19	28.53
pH	6.54	6.74	6.41	6.81	6.59	6.90	6.89
Dissolved Oxygen (mg/L)	3.33	4.76	1.29	3.18	2.20	1.73	1.48
Specific Conductivity (uS/cm)	827	3150	803	1176	749	1850	677
ORP (mV)	251	225	225	245	36	57	-2
Turbidity (NTU)(see Note 3)	5.0	4.4	5.1	10.8	2.4	61.1	16.2
Flow rate (mL/min)	200	200	300	100	300	350	100

Notes:

- Measurements were taken during purging about every five minutes. The measurements shown in the table are at the end of purging.
The initial static water levels shown are prior to purging in ft below top of casing (TOC).
- Well B-11 was purged to dryness due to low yield on June 15 and sampled on June 18 and June 21. Consequently, no well purging statistics were recorded.
- The field multimeter turbidity calibration for the zero standard was biased high during June 18-21, likely due to an instrumentation or sensor issue.
The bias, which ranged from 21 to 22.2 NTU, was subtracted from the field measurement to provide a corrected turbidity value, which is shown in the above table.
Field turbidity measurements were corrected as follows: June 18 by 22.2 NTU, June 19 by 22 NTU, June 21 by 21 NTU, and June 22 by 22 NTU.
The corrected turbidity measurement for well MW-17B was set to zero since the subtraction resulted in a negative value (-1.0 NTU).

Table 2
Mercury Concentrations in Groundwater
Sitewide Groundwater Monitoring Program, June 2007
Caribbean Petroleum Refining, LP
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Well / Sample ID	MCL		TB-3	MP-5A	MP-5B2	B-11	MW-14A2	MW-15B2	MW-17B	MW-20B
Lab ID		Units	J63993-20/20F	J63993A-22/22F	J63993A-23/23F	J63993-11/A-21F	J63993A-25/25F	J63993A-24/24F	J63993-13/13F	J63993-18/18F
Sample Date			20-Jun-07	21-Jun-07	21-Jun-07	18 & 21-Jun-07	21-Jun-07	21-Jun-07	18-Jun-07	20-Jun-07
Dissolved Mercury	2	ug/L	0.037 U	0.037 U	0.037 U	0.037 U	0.72 R	0.037 U	0.088 B	0.080 B
Total Mercury	2	ug/L	0.037 U	0.037 U	0.037 U	0.037 U	0.33 R	0.037 U	0.037 U	0.037 U
Solids, Total Dissolved (TDS)	na	mg/L	473	162	562	813	133	610	309	995
Solids, Total Suspended (TSS)	na	mg/L	< 4.0	< 4.0	5.0	260	4.0	4.0	< 4.0	< 4.0

Any results that exceed the MCL are shown shaded.

Well / Sample ID	MCL		MW-21B	MW-63A	MW-75B	MW-78B	MW-110B2	MW-110B2D	MW-115B2
Lab ID		Units	J63993-19/19F	J63993-14/14F	J63993-9/9F	J63993-12/12F	J63993-15/15F	J63993-16/16F	J63993-17/17F
Sample Date			20-Jun-07	19-Jun-07	14-Jun-07	18-Jun-07	19-Jun-07	19-Jun-07	19-Jun-07
							(duplicate)		
Dissolved Mercury	2	ug/L	0.037 U	0.044 B	0.037 U	1.6	0.037 U	0.062 B	0.037 U
Total Mercury	2	ug/L	0.46	0.86	0.044 B	2.2	0.059 B	0.047 B	0.037 U
Solids, Total Dissolved (TDS)	na	mg/L	559	105	484	2250	1240	1300	391
Solids, Total Suspended (TSS)	na	mg/L	4.0	< 4.0	19.0	< 4.0	< 4.0	7.0	< 4.0

Any results exceeding the MCL are shown shaded.

na - not applicable

U - compound was analyzed for, but not detected at or above the method detection limit shown

B - concentration is greater than the method detection limit, but less than the reporting limit

R - rejected during data validation

MCL - EPA Maximum Contaminant Level

Notes:

1. Metal results are reported to the method detection limit.
2. Analysis for TDS and TSS was performed to assist with the evaluation of mercury data.
3. Well B-11 was sampled for total mercury on June 18 and for dissolved mercury on June 21.

Table 3
Historic Mercury Concentrations in Groundwater (ug/L)
Caribbean Petroleum Refining LP
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Sample Date	MW-14A2	MW-14A2	MW-15B2	MW-15B2	MW-17B	MW-17B	MW-20B	MW-20B	MW-21B	MW-21B	MW-63A	MW-63A	MW-75B	MW-75B	MW-78B	MW-78B
Well	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
		(See Note 3)		(See Note 4)												
Historic Data																
Mar-96	---	0.1 U	---	0.1 U	---	---	---	0.1 U	---	7.8	---	1.5	---	0.1 U	---	3.3
Sep-96	---	0.4	---	0.39	---	---	---	0.1 U	---	8.1	---	1.8	---	0.23	---	0.1 U
Mar-97	---	---	---	---	---	---	---	---	---	5.8	---	---	---	---	---	2.4
Sep-97	---	---	---	---	---	---	---	---	---	0.51	---	---	---	---	---	3.3
Mar-98	---	---	---	---	---	---	---	---	---	3.3	---	---	---	---	---	3
Sep-98	---	---	---	---	---	---	---	---	---	4.6	---	---	---	---	---	2.5
Mar-99	---	---	---	---	---	---	---	---	---	2.4	---	---	---	---	---	2.9
Sep-99	---	---	---	---	---	---	---	---	---	0.57	---	---	---	---	---	---
Mar-00	---	---	---	---	---	---	---	---	---	1 J	---	---	---	---	---	2.8 J
Sep-00	---	---	---	---	---	---	---	---	---	1.0 J	---	---	---	---	---	---
Mar-01	---	---	---	---	---	---	---	---	---	1.0 J	---	---	---	---	---	2.0 J
Sep-01	---	---	---	---	---	---	---	---	---	1.4	---	---	---	---	---	2.6
Mar-02	---	---	---	---	---	---	---	---	---	1.5	---	---	---	---	---	1.5
Sep-02	---	---	---	---	---	---	---	---	---	0.43 J	---	---	---	---	---	2.3 J
May-03	---	---	0.09 UJ	0.09 UJ	---	---	0.09 U	0.09 U	0.09 U	2.2	---	---	0.2 B	0.1 U	1.4	0.1 U
Jul-03	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Oct-03	---	---	0.04 U	---	---	---	0.04 B	---	---	3.4	---	---	0.24 U	---	2.3	---
Mar-04	---	---	---	---	---	---	---	---	---	0.55 J	---	---	---	---	---	0.55 J
Sep-04	---	---	---	---	---	---	---	---	---	8.3	0.05 BJ	---	---	---	---	1.1
Mar-05	---	---	---	---	---	---	---	---	---	0.54	---	---	---	---	---	1.9
Sep-05	---	---	---	---	---	---	---	---	---	0.27	---	---	---	---	---	1.4
Mercury Investigation Data																
Jul-06	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U	2.3	0.74	0.26	0.10 B	0.088 B	0.080 U	1.9	1.8
Sep-06	0.080 U	---	0.080 U	---	0.080 U	0.080 U	0.080 U	0.080 U	0.81	0.57	0.22	0.10 B	0.080 U	0.080 U	1.7	1.6
Jun-07	0.33 R	0.72 R	0.037 U	0.037 U	0.037 U	0.088 B	0.037 U	0.080 B	0.46	0.037 U	0.86	0.044 B	0.037 U	0.044 B	2.2	1.6

Concentrations shown are in ug/L

Concentrations at or above the mercury MCL of 2 ug/L are shown bolded and shaded

Table 3
Historic Mercury Concentrations in Groundwater (ug/L)
Caribbean Petroleum Refining LP
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Sample Date	TB-3	TB-3	MP-5A	MP-5A	MP-5B2	MP-5B2	B-11	B-11	MW-110B2	MW-110B2	MW-115B2	MW-115B2
Well	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Historic Data												
Mar-96	---	---	---	---	---	---	---	---	---	---	---	---
Sep-96	---	---	---	---	---	---	---	---	---	---	---	---
Mar-97	---	---	---	---	---	---	---	---	---	---	---	---
Sep-97	---	---	---	---	---	---	---	---	---	---	---	---
Mar-98	---	---	---	---	---	---	---	---	---	---	---	---
Sep-98	---	---	---	---	---	---	---	---	---	---	---	---
Mar-99	---	---	---	---	---	---	---	---	---	---	---	---
Sep-99	---	---	---	---	---	---	---	---	---	---	---	---
Mar-00	---	---	---	---	---	---	---	---	---	---	---	---
Sep-00	---	---	---	---	---	---	---	---	---	---	---	---
Mar-01	---	---	---	---	---	---	---	---	---	---	---	---
Sep-01	---	---	---	---	---	---	---	---	---	---	---	---
Mar-02	---	---	---	---	---	---	---	---	---	---	---	---
Sep-02	---	---	---	---	---	---	---	---	---	---	---	---
May-03	0.2 B	0.1 U	---	---	---	---	---	---	---	---	---	---
Jul-03	---	---	0.12 BJ	0.24 J	0.16 BJ	0.14 BJ	0.09 UJ	0.09 UJ	---	---	---	---
Oct-03	0.18 U	---	0.10 UJ	---	0.15 UJ	---	0.82 B	---	---	---	---	---
Mar-04	---	---	---	---	---	---	---	---	---	---	---	---
Sep-04	---	---	---	---	---	---	---	---	1.6	0.05 B	0.11 BJ	0.04 UJ
Mar-05	---	---	---	---	---	---	---	---	---	---	---	---
Sep-05	---	---	---	---	---	---	---	---	---	---	---	---
Mercury Investigation Data												
Jul-06	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U	0.080 U	0.09 UJ	0.09 UJ	0.080 U	0.080 U	0.080 U	0.080 U
Sep-06	0.080 U	0.080 U	0.080 U	---	0.080 U	---	0.080 U	---	0.080 U	0.080 U	0.080 U	0.080 U
Jun-07	0.037 U	0.037 U	0.037 U	0.037 U	0.037 U	0.037 U	0.037 U	0.037 U	0.059 B	0.062 B	0.037 U	0.037 U

Concentrations shown are in ug/L

Concentrations at or above the mercury MCL of 2 ug/L are shown bolded and shaded

Codes:

'--' = No data available

J = Estimated concentration.

U = Compound was analyzed for but not detected at the concentration shown.

B = For results prior to July 2006, indicates that the concentration is between the instrument detection limit and contract required detection limit.

B = For results from July 2006 and afterwards, indicates concentration is between the method detection limit and reporting limit.

R = Rejected, data validation indicates that the data are not useable.

Notes:

- Where duplicate samples were collected, the higher value is shown
- Analyses prior to July 2006 were performed using Contract Laboratory Procedures. Analyses from July 2006 and afterwards were performed using SW-846 Method 7470A.
- Dissolved mercury results for March and September 1996 shown for well MW-14A2 are from well MW-14A, which was subsequently replaced by well MW-14A2
- Dissolved mercury results for March and September 1996 shown for well MW-15B2 are from well MW-15B, which was subsequently replaced by well MW-15B2.

Table 4
VOC Concentrations in Groundwater
Sitewide Groundwater Monitoring Program, June 2007
Caribbean Petroleum Refining, LP
(Page 1 of 1)

Well ID	MCL	MW-75B	MW-75B D	MW-83B1	MW-83B2	MW-84B2
Lab ID	or RBSL ¹	J63993-3	J63993-4	J63993-2	J63993-1	J63993-5
Sample Date		14-Jun-07	14-Jun-07	13-Jun-07	13-Jun-07	14-Jun-07
VOCs (Reporting units are in ug/L)		(duplicate)				
Acetone	<i>5500</i>	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	5	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	<i>8.5</i>	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone (MEK)	<i>7000</i>	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Carbon disulfide	<i>1000</i>	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon tetrachloride	5	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	<i>3.6</i>	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	80	1.0 U	1.0 U	0.47 J	1.0 U	1.0 U
Chloromethane	<i>190</i>	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Dibromochloromethane	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	<i>900</i>	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	5	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene	7	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	19.1	19.3	15.7	16.2	1.0 U
trans-1,2-Dichloroethene	100	3.1	3.3	3.9	2.1	1.0 U
1,2-Dichloropropane	5	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,3-Dichloropropene	<i>0.44</i>	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	<i>0.44</i>	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	700	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Hexanone	--	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Methyl Tert Butyl Ether	<i>20</i>	5.0	5.1	2.4	5.6	4.2
4-Methyl-2-pentanone(MIBK)	<i>6300</i>	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Methylene chloride	5	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Naphthalene	<i>6.5</i>	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	<i>0.053</i>	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	5	0.52 J	0.61 J	1.8	2.0	1.0 U
Toluene	1000	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,1-Trichloroethane	200	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5	67.0	69.7	133	107	1.0 U
Vinyl chloride	2	1.6	1.7	2.8	1.0 U	1.0 U
Xylene (total)	10000	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U

Any results exceeding MCLs or RBSLs are shown shaded.

U - compound was analyzed for, but not detected at or above the reporting limit shown

-- MCL and/or RBSL not available

J - estimated

Notes:

1. EPA Maximum Contaminant Levels (MCLs) are shown in bold. For compounds without MCLs, EPA Region 3 risk-based screening levels for tap water (Oct 2007) are shown in italics. The screening level for MTBE is from the lower end of the range from the EPA acceptable drinking water guideline (EPA, 1997).

Table 5
Historic Chlorinated Hydrocarbon Concentrations in Groundwater (ug/L)
 Caribbean Petroleum Refining, LP
 (Page 1 of 3)

ANALYTES	SAMPLE DATE				
		MW-75B	MW-83B1	MW-83B2	MW-84B2
Trichloroethene (TCE) MCL = 5	Mar-96	80	--	--	--
	Sep-96	69	--	--	--
	Mar-97	71	--	--	--
	Sep-97	45	--	--	--
	Mar-98	45	--	--	--
	Sep-98	50	--	--	--
	Mar-99	52	--	--	--
	Sep-99	78	--	--	--
	Mar-00	85	--	--	--
	Sep-00	72 J	--	--	--
	Mar-01	89	--	--	--
	Sep-01	90.1	--	--	--
	Mar-02	54.8	--	--	--
	Sep-02	48.5 J	--	--	--
	May-03	83.8	154 J	127 J	12.9 J
	Oct-03	106	138	122	68.7
	Mar-04	100	--	--	--
	Sep-04	68.3	--	--	--
	Feb-05	72.3	--	--	--
	Sep-05	75.5	--	--	--
	Mar-06	51.2	103	111	4.9
	Sep-06	60.9	71.6	120	0.44
	Mar-07	41.5 J	--	--	--
	Jun-07	69.7	133	107	1 U
Tetrachloroethene (PCE) MCL = 5	Mar-96	3 J	--	--	--
	Sep-96	10 U	--	--	--
	Mar-97	10 U	--	--	--
	Sep-97	10 U	--	--	--
	Mar-98	10 U	--	--	--
	Sep-98	10 U	--	--	--
	Mar-99	10 U	--	--	--
	Sep-99	1 J	--	--	--
	Mar-00	10 U	--	--	--
	Sep-00	10 U	--	--	--
	Mar-01	2 J	--	--	--
	Sep-01	1.1	--	--	--
	Mar-02	0.70 J	--	--	--
	Sep-02	0.4 J	--	--	--
	May-03	0.8 J	3.6	2.5	1 U
	Oct-03	1.5	3.4	2.1	1.2
	Mar-04	2.0	--	--	--
	Sep-04	1.0	--	--	--
	Feb-05	1.1	--	--	--
	Sep-05	0.99 J	--	--	--
	Mar-06	0.62	1.2	2.0	1 U
	Sep-06	0.49 J	0.78 J	1.7	1 U
	Mar-07	0.45 J	--	--	--
	Jun-07	0.61 J	1.8	2.0	1 U

Table 5
Historic Chlorinated Hydrocarbon Concentrations in Groundwater (ug/L)
 Caribbean Petroleum Refining, LP
 (Page 2 of 3)

ANALYTES Units in ug/L	SAMPLE DATE				
		MW-75B	MW-83B1	MW-83B2	MW-84B2
Cis-1,2-dichloroethene MCL = 70	Mar-96	44	--	--	--
	Sep-96	32	--	--	--
	Mar-97	23	--	--	--
	Sep-97	22	--	--	--
	Mar-98	10 U	--	--	--
	Sep-98	17	--	--	--
	Mar-99	24	--	--	--
	Sep-99	40	--	--	--
	Mar-00	49	--	--	--
	Sep-00	62	--	--	--
	Mar-01	45	--	--	--
	Sep-01	31.6	--	--	--
	Mar-02	16.5	--	--	--
	Sep-02	16.4	--	--	--
	May-03	45.3	20	15.2	2.9
	Oct-03	71.7	15.6	18.1	18.4
	Mar-04	48	--	--	--
	Sep-04	25.5	--	--	--
	Feb-05	23.6	--	--	--
	Sep-05	26.0	--	--	--
	Mar-06	17.6	11.1	13.3	1.0
	Sep-06	25.3	7.9	13.6	0.27 J
	Mar-07	13.6	--	--	--
	Jun-07	19.3	15.7	16.2	1 U
Trans-1,2-dichloroethene MCL = 100	Mar-96	44	--	--	--
	Sep-96	32	--	--	--
	Mar-97	23	--	--	--
	Sep-97	22	--	--	--
	Mar-98	10 U	--	--	--
	Sep-98	17	--	--	--
	Mar-99	24	--	--	--
	Sep-99	40	--	--	--
	Mar-00	49	--	--	--
	Sep-00	62	--	--	--
	Mar-01	45	--	--	--
	Sep-01	5.5	--	--	--
	Mar-02	2.7 J	--	--	--
	Sep-02	2.5	--	--	--
	Oct-03	10.4	2.2	2.2	5.9
	Mar-04	7.6	--	--	--
	Sep-04	3.3	--	--	--
	Feb-05	3.5	--	--	--
	Sep-05	3.4	--	--	--
	Mar-06	2.8	2.4	1.9	0.59 J
	Sep-06	3.1	1.2	2.3	1 U
	Mar-07	1.7	--	--	--
	Jun-07	3.3	3.9	2.1	1 U

Table 5
Historic Chlorinated Hydrocarbon Concentrations in Groundwater (ug/L)
 Caribbean Petroleum Refining, LP
 (Page 3 of 3)

ANALYTES Units in ug/L	SAMPLE DATE	MW-75B	MW-83B1	MW-83B2	MW-84B2
Vinyl chloride MCL = 2	Mar-96	10 U	--	--	--
	Sep-96	10 U	--	--	--
	Mar-97	10 U	--	--	--
	Sep-97	10 U	--	--	--
	Mar-98	10 U	--	--	--
	Sep-98	10 U	--	--	--
	Mar-99	10 U	--	--	--
	Sep-99	3 J	--	--	--
	Mar-00	2 J	--	--	--
	Sep-00	10 U	--	--	--
	Mar-01	3 J	--	--	--
	Sep-01	2.4	--	--	--
	Mar-02	2.2	--	--	--
	Sep-02	1.2	--	--	--
	May-03	3.1	2.6	1.2	1 U
	Oct-03	5.8	1 U	1 U	1.3
	Sep-04	1.6	--	--	--
	Feb-05	1.7	--	--	--
	Sep-05	1.9	--	--	--
	Mar-06	1.3	2.1	0.79 J	1 U
	Sep-06	2.3	0.84 J	1.5	1 U
	Mar-07	1.1	--	--	--
	Jun-07	1.7	2.8	1 U	1 U

Detections at or above MCLs are shown bolded and shaded

Codes:

'--' = Not sampled

U = Compound was analyzed for, but not detected at or above the concentration shown

J = Estimated concentration

Notes:

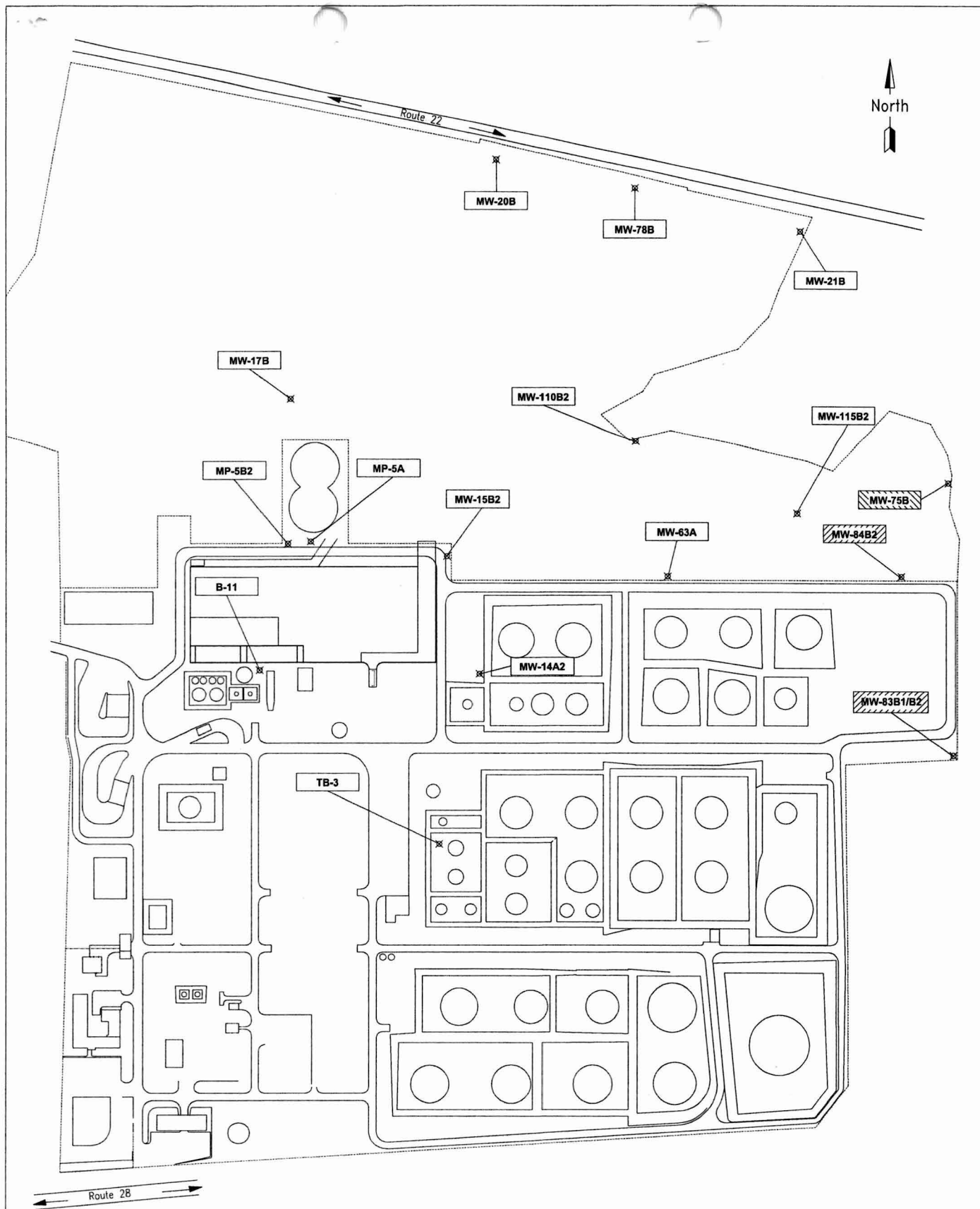
- Analyses were performed using CLP methods from March 1996 to March 2001. SW-846 Method 8260B was used thereafter.
- Where duplicate sampling was performed for QA/QC purposes, the higher of the primary and duplicate concentrations is shown.
- At well MW-75B, during March 1996 to March 2001, sampling was not performed for cis-1,2-dichloroethene and trans-1,2-dichloroethene, but for total 1,2-dichloroethene (DCE). Results shown for cis- and trans- DCE during these dates are for total DCE.

Table 6
Summary of pH and Specific Conductivity Measurements in Groundwater
Caribbean Petroleum Refining LP
(Page 1 of 1)

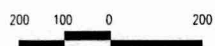
Sample Date Well	MW-14A2	MW-15B2	MW-17B	MW-20B	MW-21B	MW-63A	MW-75B	MW-78B	TB-3	MP-5A	MP-5B2	B-11	MW-83B1	MW-83B2	MW-84B2	MW-110B2	MW-115B2
pH																	
Jul-06	4.80	6.80	6.50	6.97	6.86	4.67	6.70	6.77	6.51	4.48	6.83	6.39	6.68	6.72	6.87	6.99	6.80
Sep-06	4.46	7.27	6.94	7.85	7.42	5.49	7.03	7.27	7.53	4.86	7.34	6.39	7.20	7.30	7.16	7.61	7.33
Jun-07	4.22	6.85	6.44	6.70	6.80	4.11	6.54	6.74	6.69	4.64	6.62	--	6.41	6.81	6.59	6.90	6.89
Specific Conductivity (uS/cm)																	
Jul-06	282	1256	553	1700	1225	200	955	3720	964	257	1195	990	913	1332	880	2190	803
Sep-06	204	1262	517	1570	1157	221	886	3328	911	234	1089	990	861	1224	817	2150	760
Jun-07	191	1097	496	1440	1000	186	827	3150	807	215	986	--	803	1176	749	1850	677

-- indicates not measured due to low well yield

Figures



SCALE (feet)



LEGEND

- MW-21B Monitoring Well Location (Mercury sampled)
- MW-83B1 Monitoring Well Location (VOCs sampled)
- MW-75B Monitoring Well Location (Mercury & VOCs sampled)

Figure 1

Location of Groundwater Monitoring Wells

Caribbean Petroleum Refining, LP
Bayamon, Puerto Rico

Sept 2006

Anderson-Mulholland & Associates, Inc.
White Plains, New York

Appendices A and B

- A. *Groundwater sampling field data sheets, June 2007 (on CD-ROM in PDF format)***
- B. *Data validation/certification reports and full laboratory data packages for SDG J63993, June 2007 groundwater sampling (on CD-ROM in PDF format)***